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as the usual limits of dosage for a streptococcic vaccine. Thomas and Ivy[30] advocate from 2-200 million, with an average dose of 25-50 million, while Park and Williams[31] vary the dose from 5-10 to 100 million or higher. Ely, Lloyd, Hitchcock and Nickson[32] report beneficial results with respect to the prophylaxis of influenza in a large group of men when 0.25, 0.5 and 1 mil of a streptococcic vaccine, containing 250 million of these organisms—per mil—were given.

When it is remembered that the vaccine used on the volunteers contained approximately 100 million per mil and that a total of about 230 million were given, it would appear that the amount was well within logical limits, particularly in the light of the relatively mild focal or constitutional reactions among those who received it.

From what has been said, it is reasonable to suppose that in the choice of organisms, the mode of preparation, the dosage and the manner of administration, there was nothing of a technical nature which would preclude the vaccine from being efficacious.

SUMMARY

During the recent investigations of 155 human volunteers to study the epidemiology of influenza, 16 different individuals developed tonsillitis apparently due to hemolytic streptococci.

All cases of tonsillitis occurred in men receiving crude nasopharyngeal washings and bronchial secretions from early, acute, typical, uncomplicated influenza patients—with exception of six cases in which the common donor had acute tonsillitis; no cases of tonsillitis occurred in those into whose nares were instilled filtered nasopharyngeal washings and bronchial secretions from influenza donors.

The causative organisms of the tonsillitis were very similar to the hemolytic streptococci isolated from the nasopharyngeal washings and bronchial secretions of the donors of the respective groups.

Three of the cases of tonsillitis developed in persons who had received, one month previously, a vaccine containing, in addition to other organisms, three presumably adequate doses of hemolytic streptococci.

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[30] Applied Immunology, 1915, p. 251.

[31] Pathogenic Micro-organisms, 1917, p. 590.

[32] Jour. Am. Med. Assn., 1919, 72, p. 24.

TWO INSTRUCTIVE OUTBREAKS OF TYPHOID FEVER

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There are a variety of channels through which the contagion of typhoid fever may be disseminated in such a manner as to cause an epidemic, but foremost among these are public water and milk supplies. In past years it has sometimes been difficult to determine positively which of these two routes was the guilty one in a given case, but with the development of modern epidemiologic methods this difficulty has been very largely overcome. Too many physicians and local health officers, however, still persist in making a guess at what might be the source of infection and then allow the matter to rest, or else collect samples of drinking water and milk at random and send them to a bacteriological laboratory to be examined for typhoid bacilli. Experience has demonstrated that these guesses are about as likely to be wrong as right, and that the task of finding the source of infection is most likely to be successful if we start with the patients and from them ascertain as nearly as possible when, where and under what conditions each case has occurred. This is clearly illustrated by one of the outbreaks of typhoid fever that I was called on to investigate recently in McGill, Nevada.

McGill is a small mining town of approximately 3,000 inhabitants. It is supported entirely by labor in copper smelters and related industries, and the entire village is owned by the Nevada Consolidated Copper Company. It has two separate public water supplies, each of which supplies a definite section of the village. One of these sources of supply is from a shallow well (known locally as "Domestic Spring" supply) located in the northern part of the village and the other is from a small mountain stream ("Duck Creek") which is carried out of the mountains in ditches and is then piped into the village. The latter water is passed through a pressure filter to remove suspended matter, but the filter does not remove bacteria from the water. The greater part of the village is sewered, but only a relatively small percentage of the toilets have sewer connection. Most of the outside privies are in a neglected and insanitary condition. Many of them are not provided with a door but are protected from view by a board screen placed about 3 feet in front of the entrance. The seat is nothing more than a rail, and the pit is not covered in any way.

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August 24, 1918, there was received at this laboratory a telegram from McGill stating that samples of milk and water were being shipped by express to determine whether or not they contained typhoid bacilli. The samples were received in good order on the following day, packed in ice, and the water samples (three in number) were submitted to the regular bacteriologic analysis. The results showed that none of the samples contained B. coli in 1 c.c. quantities, but sample 1 (dairy well), and sample 2 ("Duck Creek" supply), yielded B. coli in 5 c.c. quantities, and the total number of colonies developing in plain agar, 1 per cent. acid, at incubator temperature in 48 hours were 50 and 172, respectively. Sample 3 (domestic spring supply), showed no gas production in lactose broth with 1 c.c. and 5 c.c. quantities, and the incubator count was 68 colonies per c.c. I therefore submitted a report stating that the results were inconclusive and advised an epidemiologic investigation of the outbreak and a field study of the water supplies. These were asked for and were made by me during the first 2 days of September with the following results:

On my arrival in McGill I learned from the company's physician that there had been no typhoid fever in the village for more than a year, but that 8 cases had suddenly come to notice between August 9 and 17, a period of 8 days. The company's physician was of the opinion that the milk supply was the source of infection because the dairy was in an insanitary condition and all patients had been using milk from the dairy—the only one in McGill.

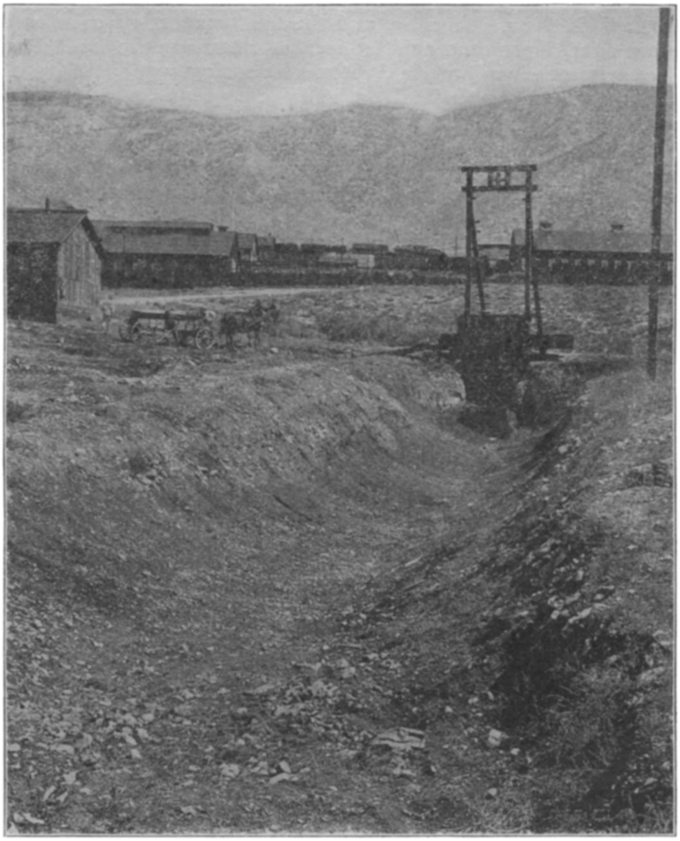
Accompanied by the chief surgeon of the Consolidated Copper Company, I visited every patient in order to get all information first hand. The information thus gathered showed that all patients had been getting milk from the only dairy in McGill and all had been supplied with drinking water from the "Domestic Spring" supply. There were no cases on the "Duck Creek" supply, although the families using this water were using the same milk as those on the other water supply. This information, therefore, pointed strongly toward the "Domestic Spring" water as the source of infection because it would be most extraordinary to have typhoid fever developing from the milk supply in those families using water from the "Domestic Spring" supply and not in those using water from the "Duck Creek" supply. This situation was explained to the company's surgeon and their engineer, and a careful inspection of the "Domestic Spring" was recommended. Before making this inspection I was assured by the engineer that the "spring" was tightly enclosed and could not possibly become contaminated.

The inspection, however, revealed a very different state of affairs. The "Domestic Spring" is in reality a shallow well about 20-25 feet in depth and situated in a small gully in the north end of the village. All surface drainage from a considerable area is into the gully and toward the well. In fact, the well is situated in a large natural ditch, as shown in the photograph. The well was lined with planks but these were in a dilapidated condition and formed no barrier against the introduction of surface filth, and rain or snow water. Moreover, a careful inspection of the premises showed that these were used rather freely by tramps in place of a privy. In fact, the heavy timber projecting from the side of the enclosure over the well (see illustration) made this a convenient place for that purpose. Our inspection revealed perfectly fresh deposits of human excrement right at the edge of the well. The filth deposited here could not escape being washed into the well whenever there was a heavy rain.

Summer rains are not of frequent occurrence in this section of the country, but it was learned that there had been a heavy rain about July 31 or August 1.

The cases of typhoid fever began to appear on August 9 and the outbreak was apparently at an end by the 17th. Evidently the immediate surroundings of the well had been polluted by a typhoid carrier shortly before this rain.

A total of eight cases were recognized during the outbreak. These ranged in age from 6-56 years. Four were between the ages of 20-30 years and three were over 30. Six were males and two were females.



Photograph of well responsible for typhoid outbreak at McGill, Nevada.

A second outbreak of more than ordinary interest and which has been definitely traced to its source, occurred in Ely, Nevada, during January, February and March, 1918.

In response to a telegram I went to Ely on March 26, 1918, and in an interview with Dr. W. S. Holmquist, health officer of White Pine County, learned that there had been reported eleven cases of typhoid fever between January 25 and March 26. It was also learned that Dr. Holmquist had made a careful inquiry into the milk supply of every patient and had found that all had been using milk from a certain dairy "M." The doctor had then visited this dairy and was informed that there had been no sickness, but that they had engaged a new helper in the dairy about January 10. On questioning this individual, it was learned that he had suffered from a severe and protracted attack of typhoid fever during October and November, 1917, and that this was in fact the first employment that he had engaged in since his recovery. On the finding of these facts, Dr. Holmquist ordered the man to leave the employ of the dairy and be confined in the county hospital, awaiting the arrival of the state bacteriologist.

After having been informed of these facts, I visited all patients who had been reported as typhoid cases, in order to gather first hand all information that might throw light on the source of infection.

The data gathered in this investigation showed that all patients had been using city water, and that all were heavy milk drinkers and had been getting milk from dairy "M." The city water was considered safe and this was verified by a bacteriologic analysis of a sample collected on March 27. Practically all of the patients had been eating at their homes and all denied having been away from Ely for over a month prior to the onset of their illness. Groceries, butter, and other supplies for table use were bought at various stores, and it did not appear that they were getting anything in common except the drinking water and the milk. All data gathered, therefore, pointed very strongly to the milk from dairy "M" as being the vehicle of infection. This conclusion was greatly strengthened by the fact that, as stated, one of the helpers who had recently come into the employ of this dairy was convalescent from typhoid fever only about six weeks before entering the employ of the dairy. This man was therefore given a brisk cathartic (magnesium sulphate) to get several specimens of stool for bacteriologic examination. Two specimens of stool and two samples of urine were obtained, and litmus lactose agar plates made from each within an hour after procuring the sample; a portable bacteriologic outfit having been taken along from the laboratory for this purpose. The plates were carried home to the laboratory and incubated for 24 hours. None of the plates from the two samples of urine, nor those from the first stool, which was fairly solid, contained any typhoid colonies. The plates from the second sample of stool, however, which was semiliquid, contained more typhoid colonies than colonies of B. coli. These organisms were then positively identified as B. typhosus by both cultural tests and agglutination tests with typhoid immune serum.

It was proven, therefore, that the outbreak of typhoid fever occurring in Ely between January 25 and March 26 was caused by the infection of a milk supply by a dairy helper who was a typhoid bacillus carrier.

One lesson that should be learned from the results of this investigation is to the effect that no person should be allowed to enter into the employ of a dairy until his past history relative to typhoid fever has been ascertained by the local health officer. If a history of typhoid